FIG. 1

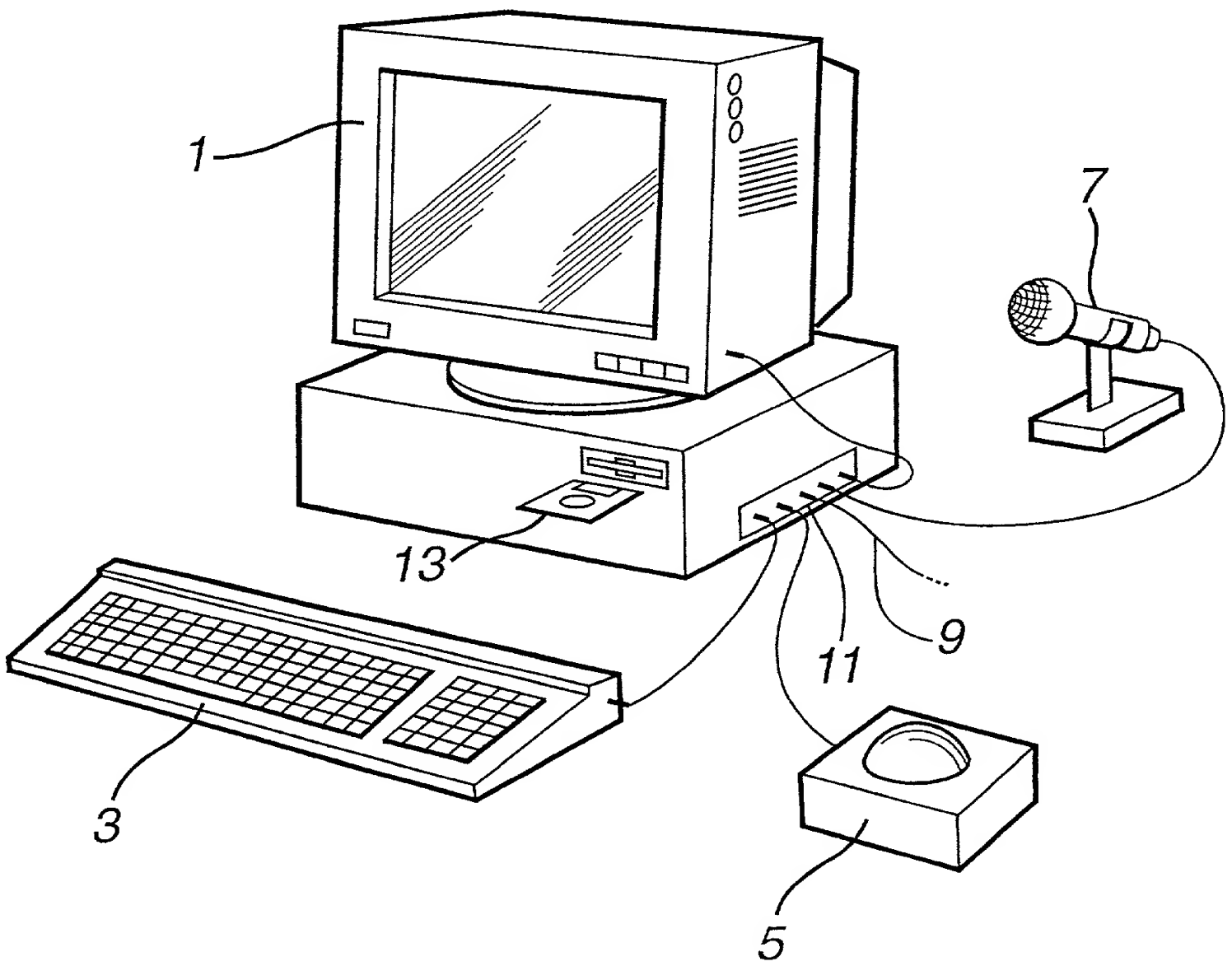


FIG. 2

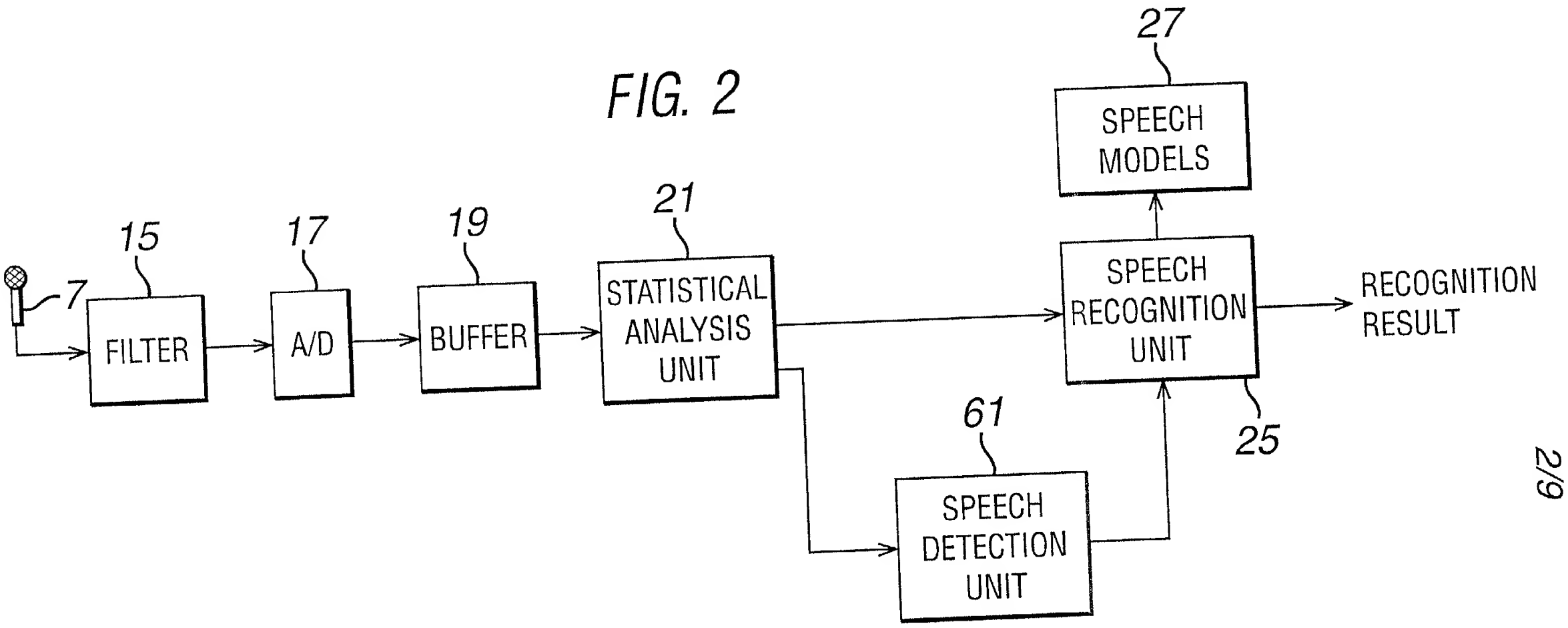

27
SPEECH MODELS
21
15
17
19
7
FILTER
A/D
BUFFER
STATISTICAL ANALYSIS UNIT
SPEECH RECOGNITION UNIT
RECOGNITION RESULT
61
25
SPEECH DETECTION UNIT

FIG. 3

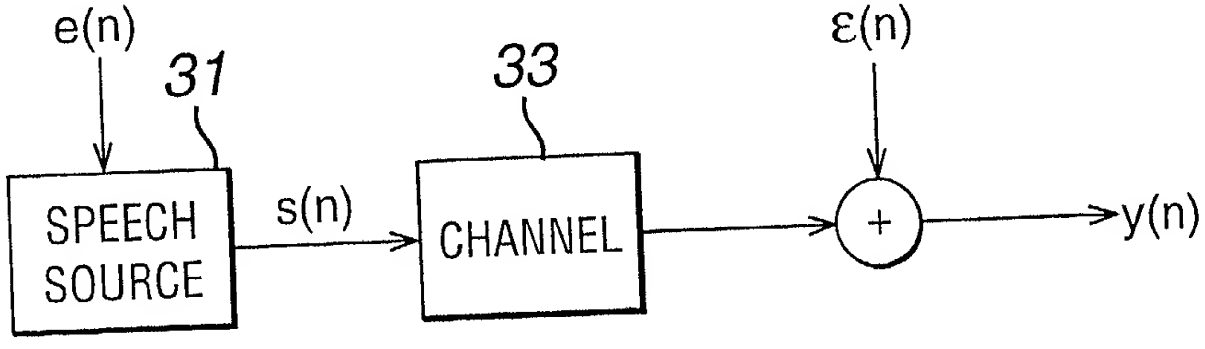

e(n)
31
33
ε(n)
SPEECH SOURCE
s(n)
CHANNEL
+
y(n)

FIG. 4

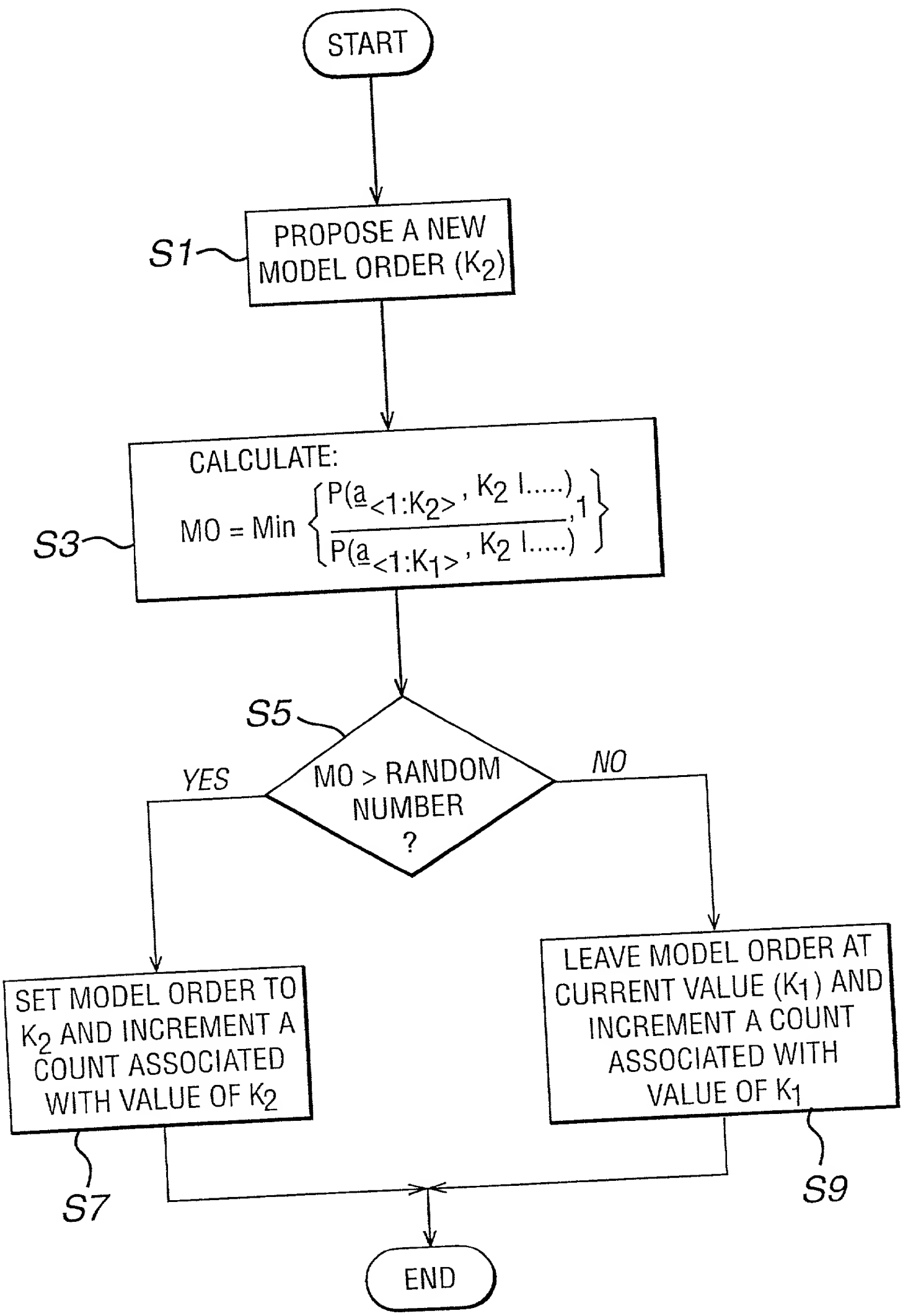

START
S1
PROPOSE A NEW MODEL ORDER (K_2)
S3
CALCULATE:
$MO = Min \left\{ \frac{P(\underline{a}_{<1:K_2>}, K_2 I.....)}{P(\underline{a}_{<1:K_1>}, K_2 I.....)}, 1 \right\}$
S5
MO > RANDOM NUMBER ?
YES
NO
SET MODEL ORDER TO K_2 AND INCREMENT A COUNT ASSOCIATED WITH VALUE OF K_2
LEAVE MODEL ORDER AT CURRENT VALUE (K_1) AND INCREMENT A COUNT ASSOCIATED WITH VALUE OF K_1
S7
S9
END

FIG. 5

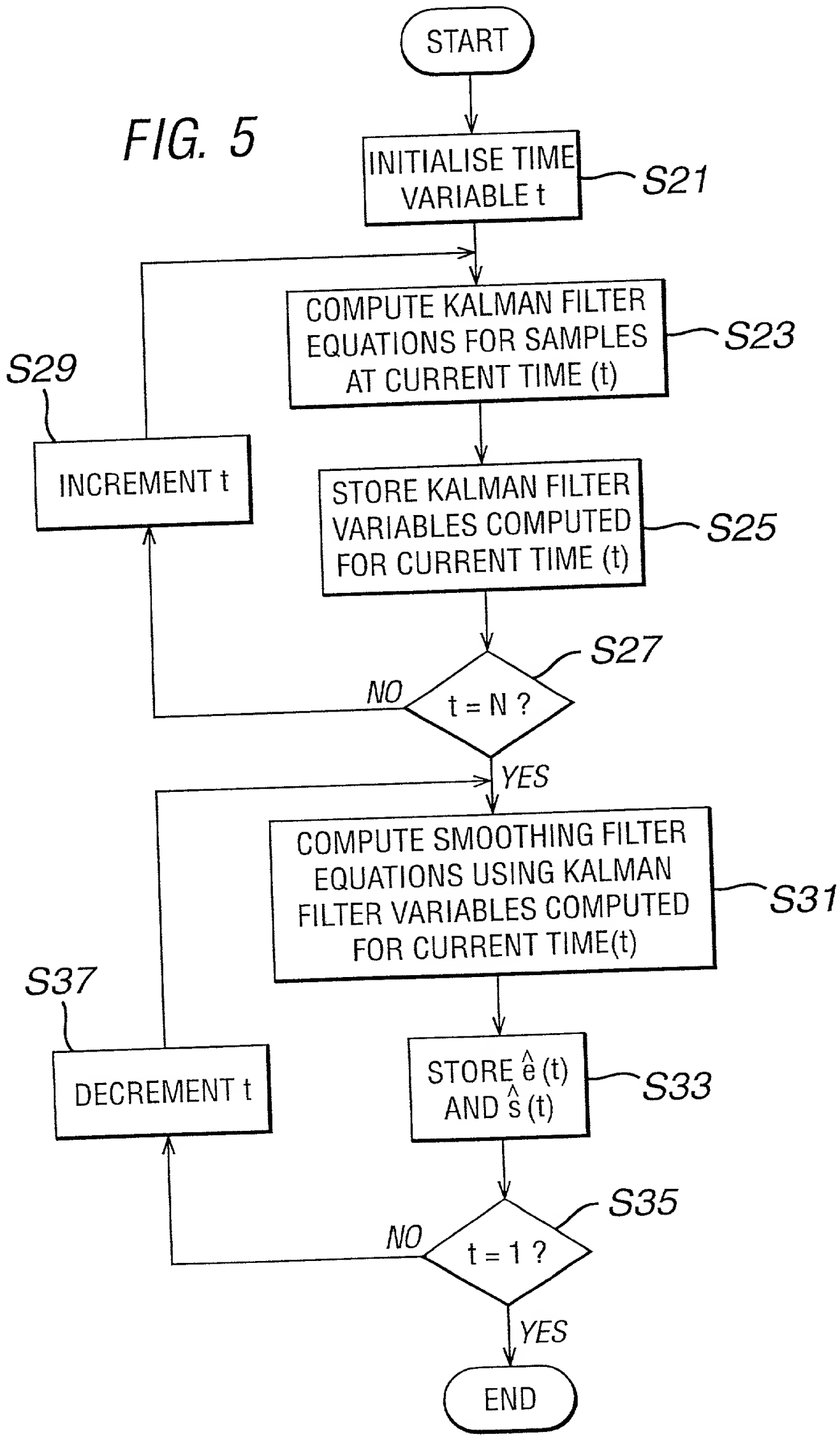

START
INITIALISE TIME VARIABLE t
S21
COMPUTE KALMAN FILTER EQUATIONS FOR SAMPLES AT CURRENT TIME (t)
S23
STORE KALMAN FILTER VARIABLES COMPUTED FOR CURRENT TIME (t)
S25
S27
t = N ?
NO
YES
S29
INCREMENT t
COMPUTE SMOOTHING FILTER EQUATIONS USING KALMAN FILTER VARIABLES COMPUTED FOR CURRENT TIME(t)
S31
STORE ê (t) AND ŝ (t)
S33
S35
t = 1 ?
NO
YES
S37
DECREMENT t
END

FIG. 6

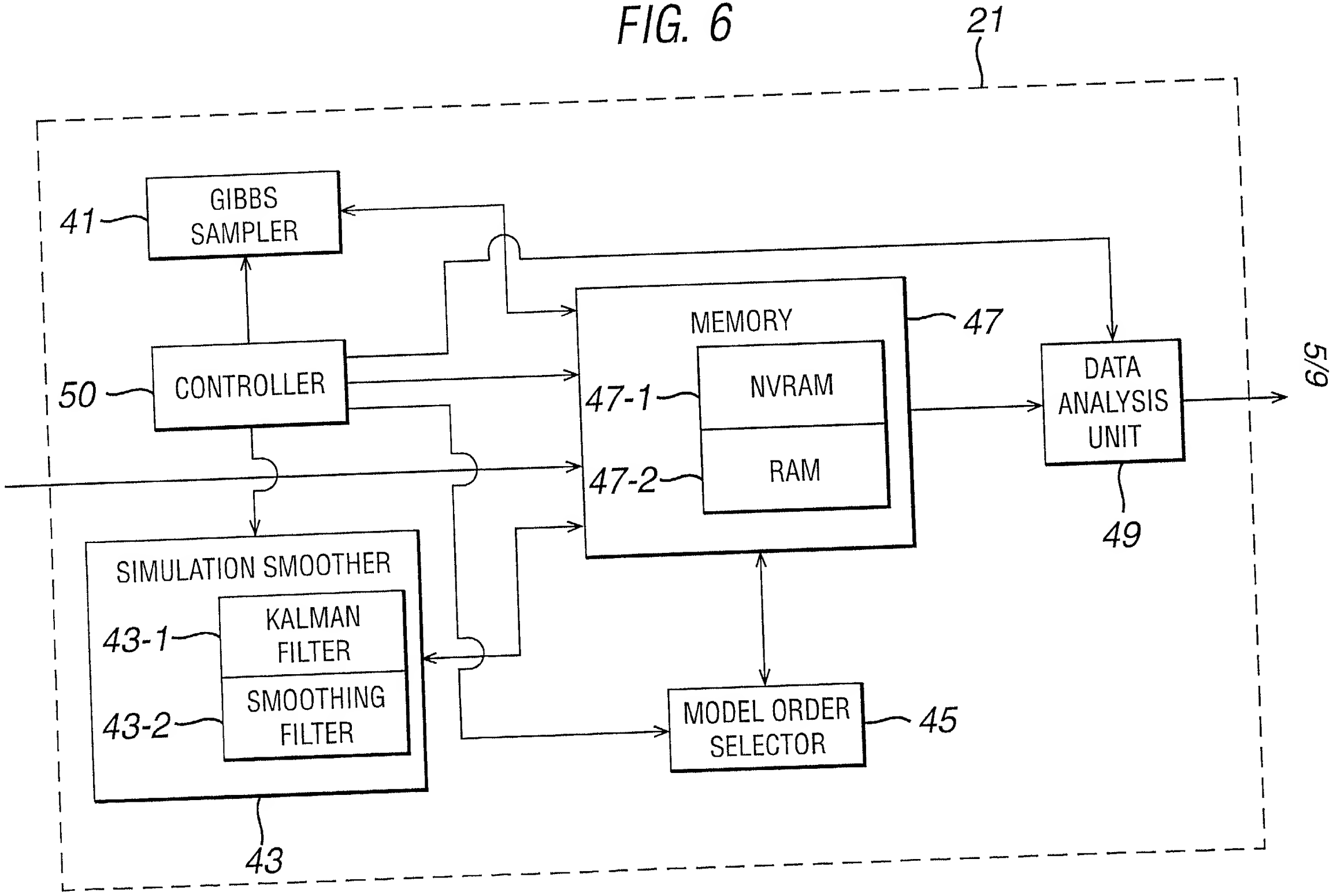

21
41
GIBBS SAMPLER
50
CONTROLLER
MEMORY
47
47-1
NVRAM
47-2
RAM
DATA ANALYSIS UNIT
49
SIMULATION SMOOTHER
43-1
KALMAN FILTER
43-2
SMOOTHING FILTER
43
MODEL ORDER SELECTOR
45

FIG. 7

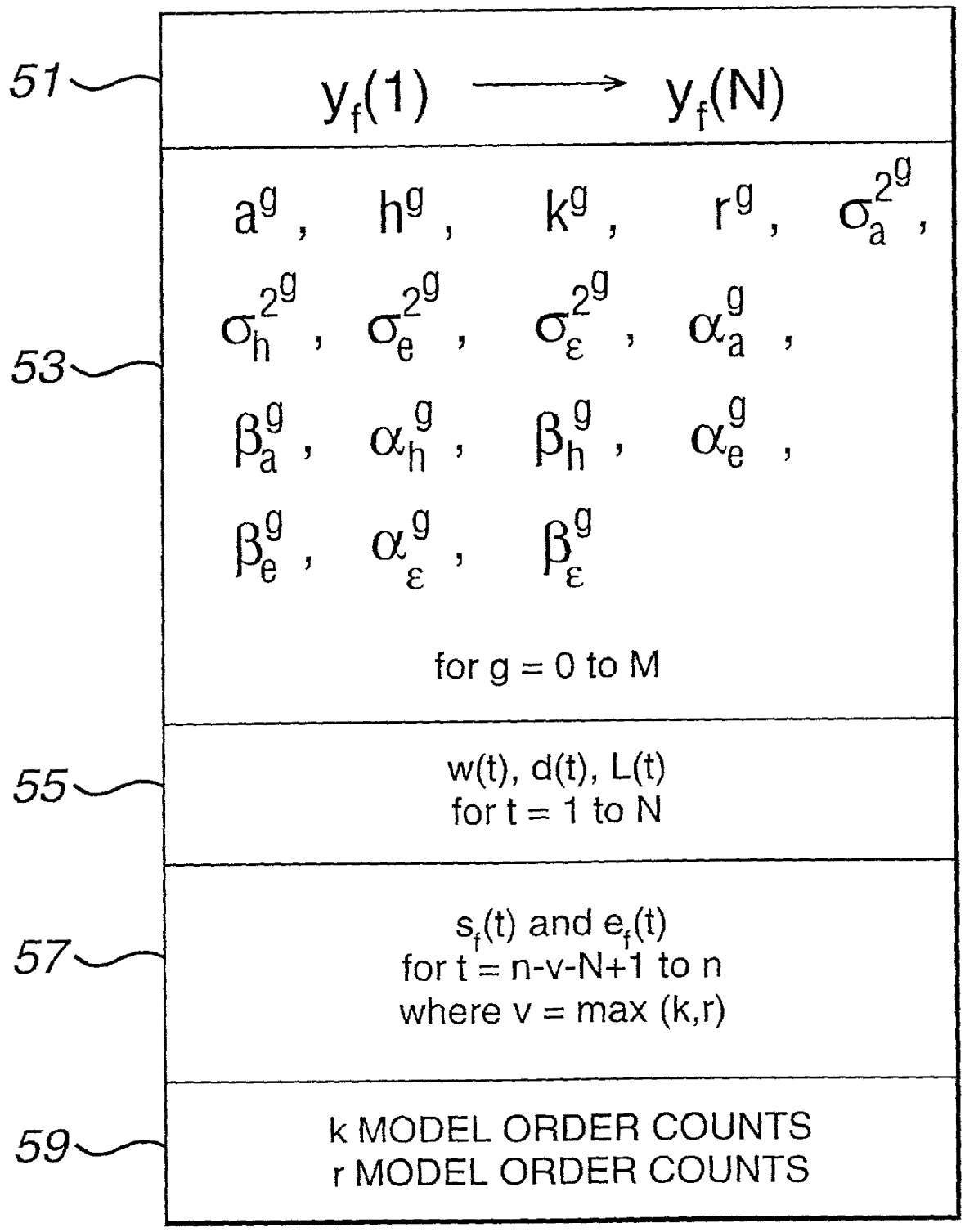

51
$y_f(1) \longrightarrow y_f(N)$
53
a^g, h^g, k^g, r^g, σ_a^{2g},
σ_h^{2g}, σ_e^{2g}, σ_ε^{2g}, α_a^g,
β_a^g, α_h^g, β_h^g, α_e^g,
β_e^g, α_ε^g, β_ε^g
for g = 0 to M
55
w(t), d(t), L(t)
for t = 1 to N
57
$s_f(t)$ and $e_f(t)$
for t = n-v-N+1 to n
where v = max (k,r)
59
k MODEL ORDER COUNTS
r MODEL ORDER COUNTS

FIG. 8

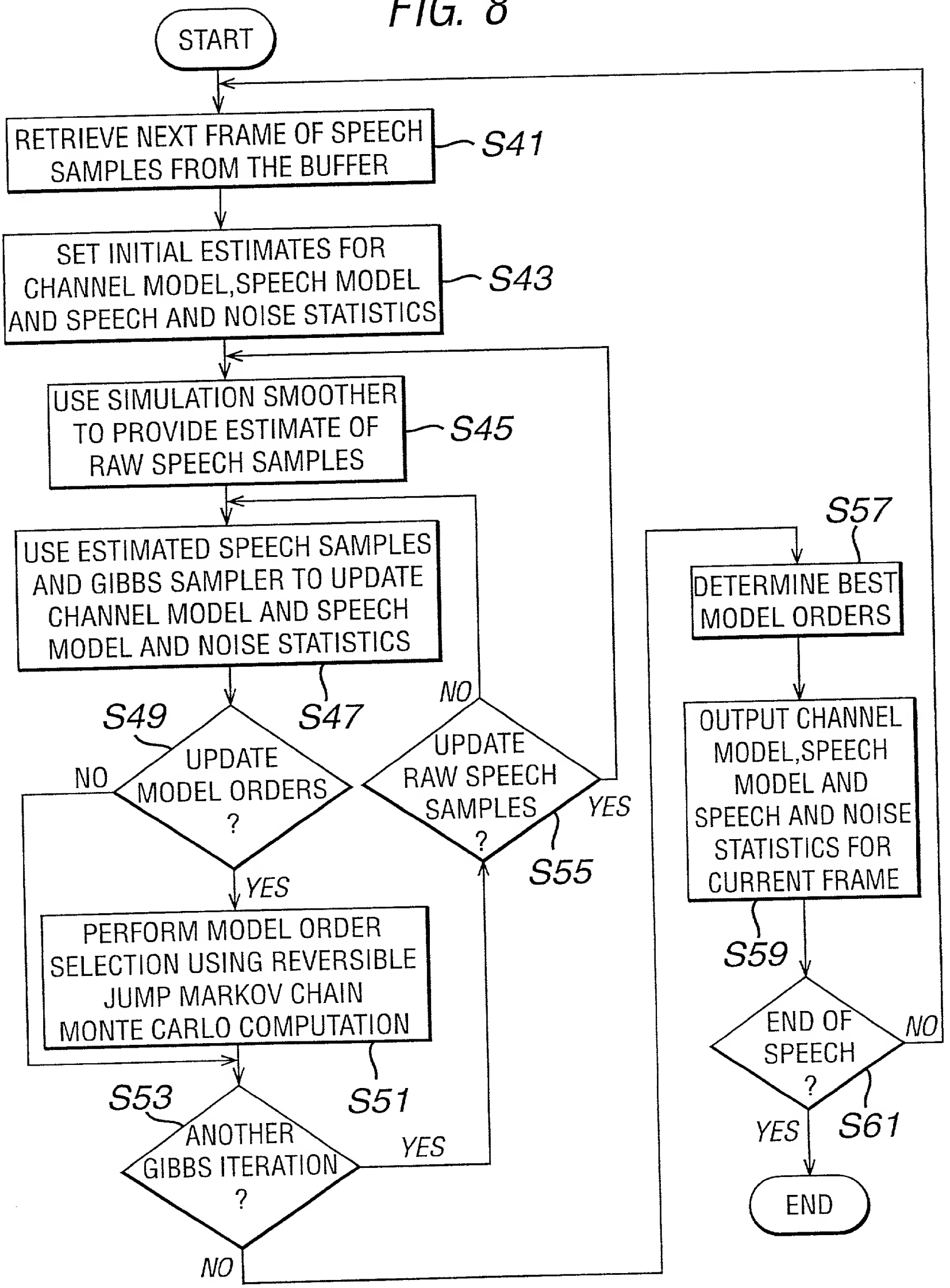

START
RETRIEVE NEXT FRAME OF SPEECH SAMPLES FROM THE BUFFER
S41
SET INITIAL ESTIMATES FOR CHANNEL MODEL,SPEECH MODEL AND SPEECH AND NOISE STATISTICS
S43
USE SIMULATION SMOOTHER TO PROVIDE ESTIMATE OF RAW SPEECH SAMPLES
S45
USE ESTIMATED SPEECH SAMPLES AND GIBBS SAMPLER TO UPDATE CHANNEL MODEL AND SPEECH MODEL AND NOISE STATISTICS
S47
S49
UPDATE MODEL ORDERS ?
NO
YES
PERFORM MODEL ORDER SELECTION USING REVERSIBLE JUMP MARKOV CHAIN MONTE CARLO COMPUTATION
S51
S53
ANOTHER GIBBS ITERATION ?
YES
NO
UPDATE RAW SPEECH SAMPLES ?
NO
YES
S55
S57
DETERMINE BEST MODEL ORDERS
OUTPUT CHANNEL MODEL,SPEECH MODEL AND SPEECH AND NOISE STATISTICS FOR CURRENT FRAME
S59
END OF SPEECH ?
NO
YES
S61
END

FIG. 9a

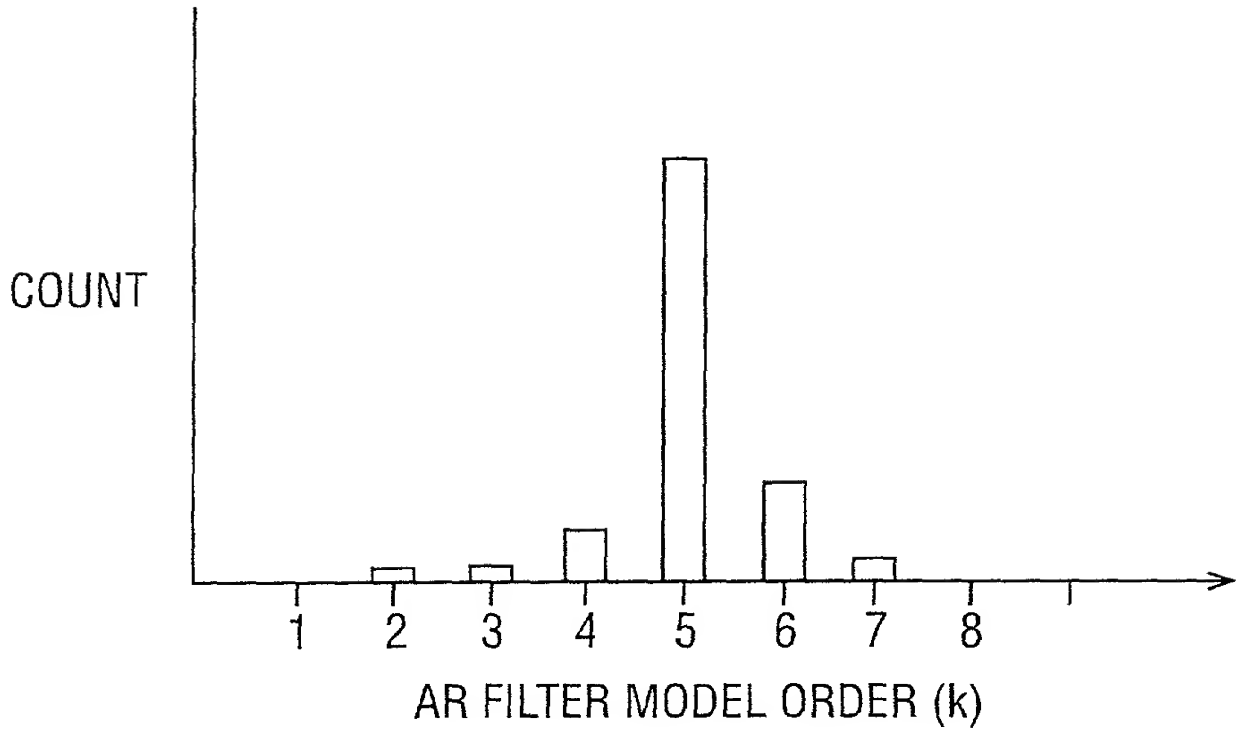
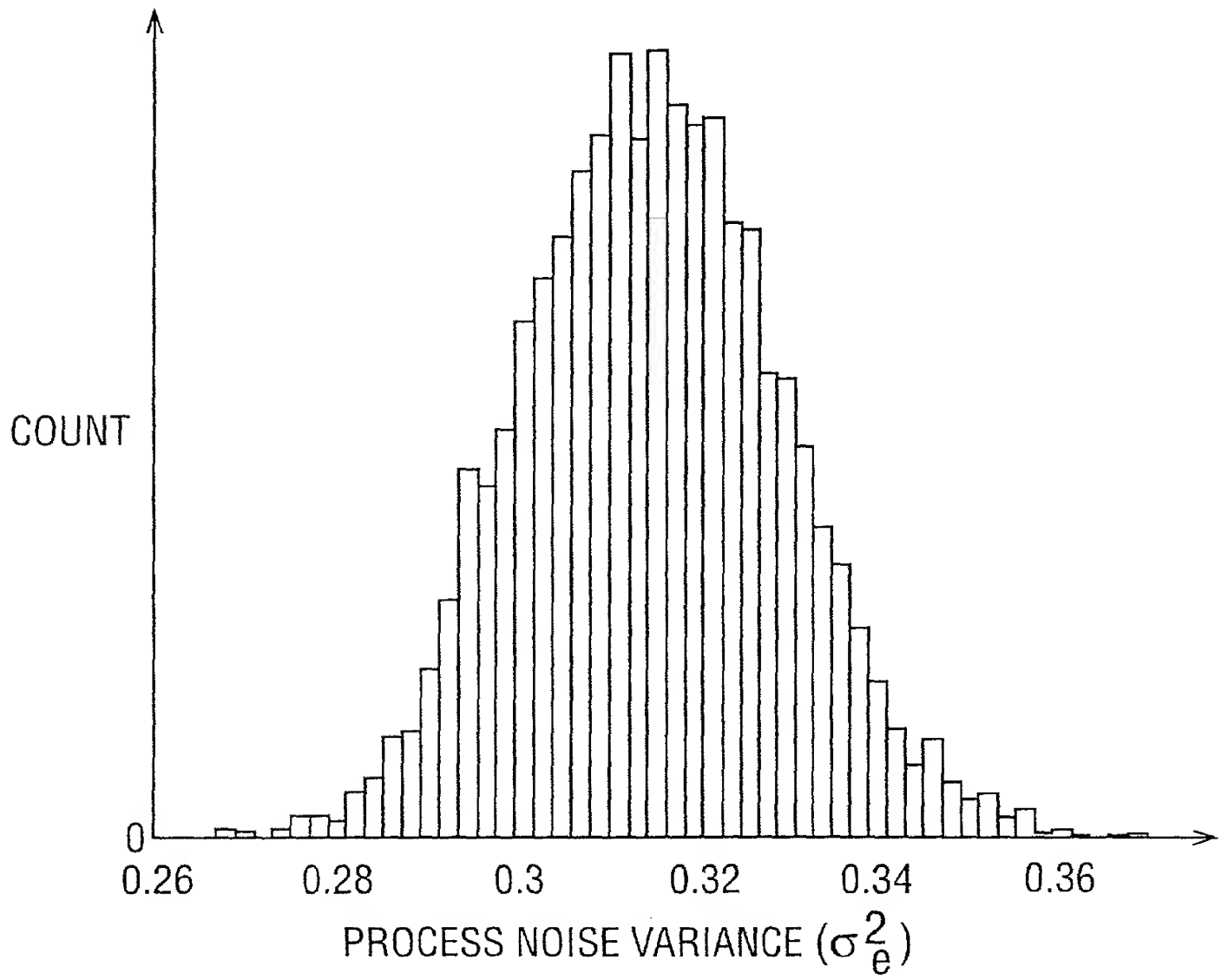

COUNT
1
2
3
4
5
6
7
8
AR FILTER MODEL ORDER (k)

FIG. 9b


COUNT
0
0.26
0.28
0.3
0.32
0.34
0.36
PROCESS NOISE VARIANCE (σ_e^2)

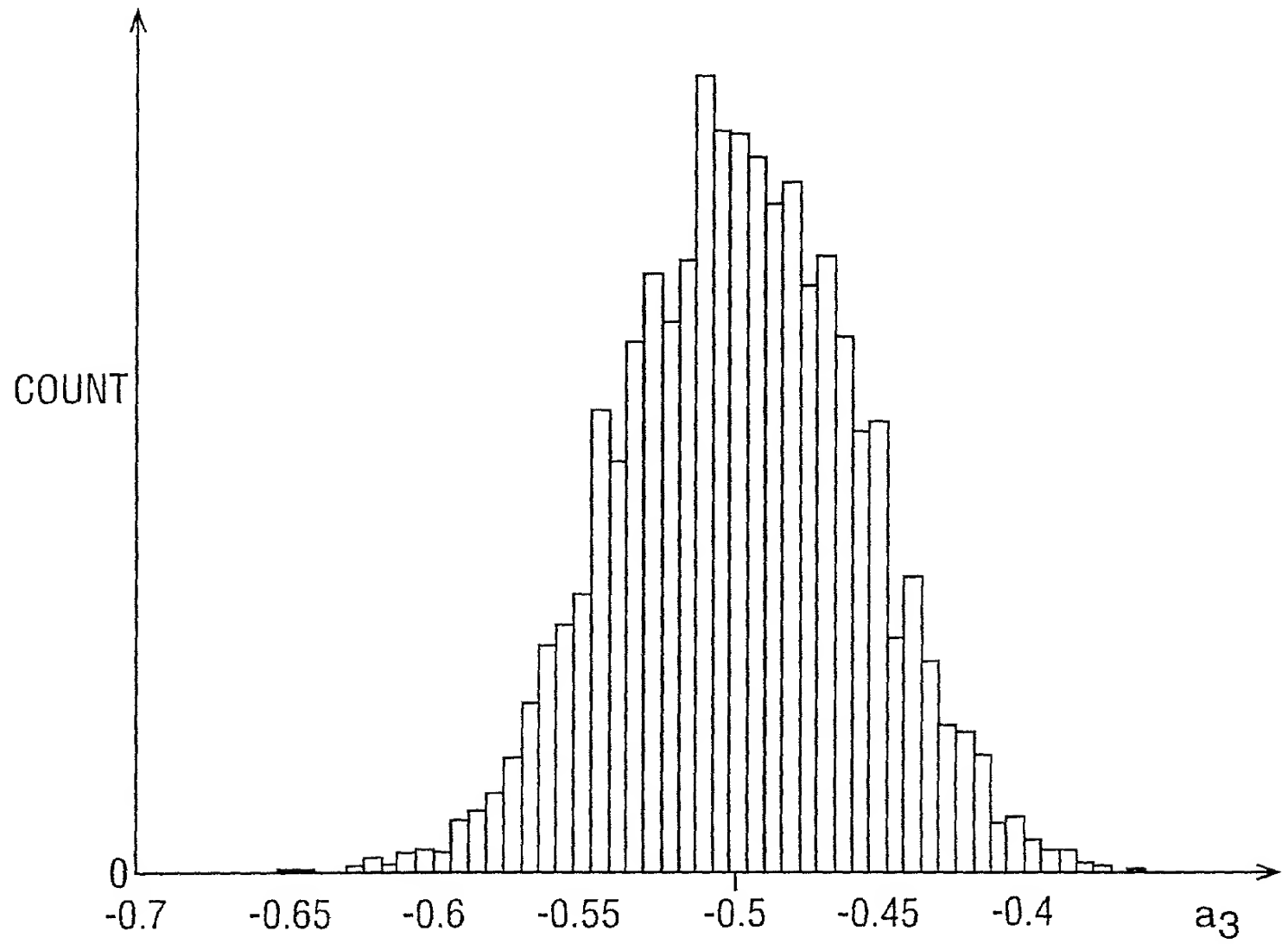



FIG. 9c